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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/687,713	10/17/2003	Kuci-Wu Huang	N1085-00184	4631
54657	7590	11/27/2006	[TSMC2002-132]	
DUANE MORRIS LLP IP DEPARTMENT (TSMC) 30 SOUTH 17TH STREET PHILADELPHIA, PA 19103-4196			EXAMINER VINH, LAN	
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 11/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/687,713

Applicant(s)

HUANG ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 September 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 17 and 20-38 is/are pending in the application.
- 4a) Of the above claim(s) 31-38 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 17 and 20-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/28/2006 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 17, 20, 21-25, 26, 28, 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leu et al (US 2003/0205823) in view of Kakamu et al (US 2004/0041267)

Leu discloses a method to improve nucleation and/or adhesion of a deposited film on a semiconductor device. The semiconductor device includes a barrier layer on a top surface of a low-k interlayer dielectric layer. The method comprises the steps of:

forming at least two copper interconnect structures within a low-k interlayer dielectric layer 42 (page 5, paragraph 0047)

treating the top surface of the low-k interlayer dielectric layer using dry chemical treatment/plasma treatment to transform a thin surface layer of the low-k interlayer dielectric layer into a copper diffusion barrier 45 (page 5, paragraphs 0043-0044), the barrier layer is SiC (page 4, paragraph 0027) having a thickness of 10 angstroms (page 5, paragraph 0046), which reads on treating the top surface of the low-k employ ion implantation using one gas wherein the copper diffusion barrier layer is a SiC layer less than 50 angstroms thick

Although Leu discloses forming a SiC barrier layer by treating the surface of the low-k layer, unlike the instant claimed inventions as per claims 1,17, Leu fails to specifically disclose treating the surface of the low-k employs ion implantation using carbon dioxide

Kakamu discloses a method for forming dual damascene comprises the step of treating the surface of a dielectric layer with plasma/ion implantation formed from carbon dioxide gas to form a barrier layer of SiC (page 4, paragraph 0056)

One skilled in the art at the time the invention was made would have found it obvious to modify Leu step of forming a SiC layer by treating the surface of the low-k with plasma/ion implantation formed from carbon dioxide as per Kakamu because Kakamu discloses that the SiC film is formed by the plasma using a process gas includes carbon dioxide (page 4, paragraph 0056)

Regarding claims 20-21, 24, Leu discloses that the low-k dielectric may be formed from low-k polymeric dielectric, organic silicon dioxide (page 4, paragraph 0041)

Regarding claims 22-23, Leu discloses forming a dual damascene structure includes copper (page 5, paragraph 0047)

Regarding claims 25, 26, 28, 29, Leu discloses a step of forming a thin layer of barrier layer of tantalum silicon nitride, SiC by CVD while heating/curing the substrate at 380 degree C (page 4, paragraph 0037; page 5, paragraph 0045-0046)

3. Claims 27, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Leu et al (US 2003/0205823) in view of Kakamu et al (US 2004/0041267) and further in view of De Felipe et al (US 6,541,374)

Leu as modified by Kakamu has been described above. Unlike the instant claimed inventions as per claim 27, 30, Leu and Kakamu fails to specifically disclose forming a thin layer of silicon nitride includes elevating the temperature of the copper damascene structure to 50-100 degree C

De Felipe discloses applying chemical that contains silicon and nitrogen to form a nitride barrier layer on the surface of the low k while keeping the temperature of the wafer at between 100-400 degree C (col 6, lines 40-51, col 7, lines 45-50)

One skilled in the art at the time the invention was made would have found it obvious to modify Leu and Kakamu by elevating the temperature of the copper damascene structure 100 degree C as per De Felipe because De Felipe discloses that a barrier layer is deposited on the wafer while the temperature of the wafer is preferably 100 degree C (col 6, lines 38-41)

Response to Arguments

4. Applicant's arguments with respect to the previously cited reference of Sudijono which argue that the barrier layer of SiC, as taught by Sudijono, has a thickness of between about 200-1000 angstroms while amended claim 1 requires a barrier layer having a thickness of less than 50 angstroms have been considered but are moot in view of the new ground(s) of rejection based on the reference of Leu that discloses treating the top surface of the low-k interlayer dielectric layer using dry chemical treatment/plasma treatment to transform a thin surface layer of the low-k interlayer dielectric layer into a copper diffusion barrier 45 (page 5, paragraphs 0043-0044), the barrier layer is SiC (page 4, paragraph 0027) having a thickness of 10 angstroms < 50 angstroms (page 5, paragraph 0046),

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1765

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'LV', is written above the typed name.

LV

November 21, 2006